

ELECTRON-IMPACT STUDIES OF OI: DIRECT EXCITATION AND EMISSION CROSS SECTIONS

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We report both direct electron-impact differential and integral cross sections of OI corresponding to the $2s^22p^43P \rightarrow 3s^3S$ (130.4 nm), $3d^3D$ (102.7 nm), $3s^3D$ (98.9 nm) and $3s^3P$ (87.8 nm) transitions at 30, 50, and 100 eV electron-impact energies. Electron-impact-induced emission cross sections of the OI $3S^0 \rightarrow 3P$ (130.4 nm) transition are also reported.

Direct excitation measurements have been made in the angular range from 0° to 25° with a conventional electrostatic electron energy-loss spectrometer. The OI differential cross sections (DCSs) were put on an absolute scale by normalization to the O_2 DCS values of Johnson and Kanik¹. Extrapolation of the measured results to larger angles was performed using theoretical calculations as a guide, and integral cross sections were derived. Theoretical calculations based on the R-matrix method² along with the experimental results of Vaughan and Doering^{3,4}, have been compared with the current measurements.

The optical excitation function of the OI $3S^0 \rightarrow 3P$ (130.4 nm) transition, produced by electron-impact excitation of OI, has been measured for the first time over an extended energy

range from threshold to 1.0 keV. Measurements were obtained in a crossed-beam experiment using both magnetically confined and electrostatically focused electrons in collision with OI produced by a microwave discharge source. A 0.2-meter vacuum ultraviolet monochromator system was used to measure the emitted OI radiation at 130.4 nm. The relative OI (130.4 nm) emission intensity corresponding to the $3S^0 \rightarrow 3P$ transition was then put on the absolute scale by normalization to the OI (130.4 nm) cross section produced by dissociative excitation of O_2 at 30 eV⁵.

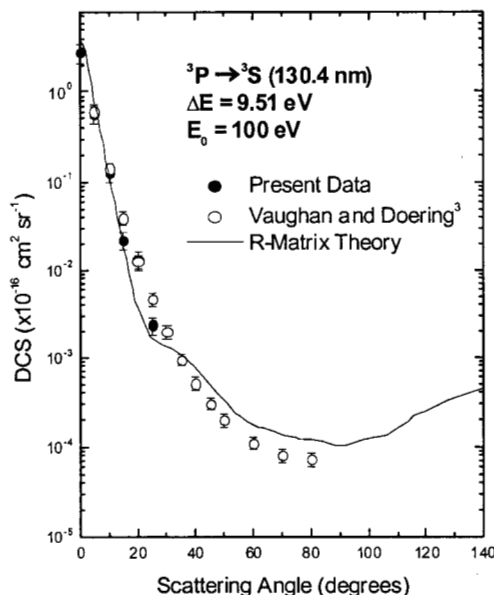


Figure 1. The $3P \rightarrow 3S$ DCS at 100 eV impact energy

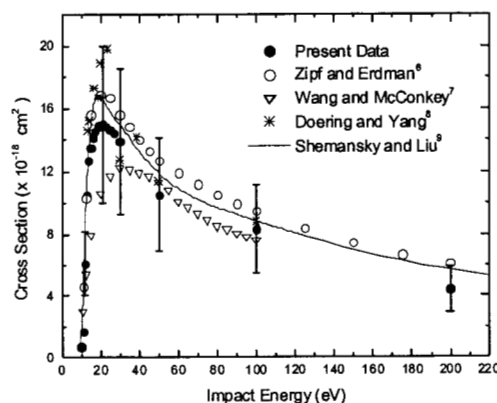


Figure 2. The OI(130.4 nm) excitation function.

References

1. Johnson PV, Kanik I to be published
2. Kanik I, Johnson PV, Das MB, Khakoo MA, Tayal SS 2001 *J. Phys. B*: submitted
3. Vaughan SO, Doering JP 1987 *J. Geophys. Res.* **91** 7749
4. Vaughan SO, Doering JP 1988 *J. Geophys. Res.* **93** 289
5. Kanik I, Noren C, Makarov O, Ajello JM, McCartney P 2000 *J. Geophys. Res.* submitted
6. Zipf EC, Erdman PW 1985 *J. Geophys. Res.* **90** 11087
7. Wang S, McConkey JW 1992 *J. Phys. B*: **25** 5461
8. Doering JP, Yang S 2001 *J. Geophys. Res.* **106** 203
9. Shemansky DE and Liu X 2001 to be published

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